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[illegible]

5 Use of pre-sorted plastic material wastes and process for producing a
granular material as a filter for the purification of sewage

10 The invention concerns the ecologically meaningful use of pre-sorted
plastic material wastes and a process for producing a granular material as a
filter for the purification of sewage and waste water.

15 The use of plastic material wastes, in particular those which have
been pre-sorted and/or purified, is known in the state of the art, as well as
various processes for producing a granular material made up of a single
kind of material, as a filter for the purification of sewage and waste water.
20 As is known, large amounts of plastic material wastes, in particular also
domestic packaging, are recycled in terms of the material involved. The
Deutsche Gesellschaft für Kunststoffrecycling GmbH, referred to for the
sake of brevity as DKR, implemented a procedure for suitably splitting up
those various plastic materials. There is a foil or sheet fraction, a plastic
25 bottle fraction, an EPS fraction, a cup fraction and a mixed plastic material
fraction. Residues are put to use by thermal processes, for example by the
production of energy by incineration. Thus DSD (Duales System
Deutschland) already represented in 1997 a utilisation quota of 86%, as is
referred to in the newspaper 'DIE WELT' of 5th February 1999. However the
30 DSD-DKR system also presents itself as being more and more market and
economy oriented. If at the present time there are still loss-making quotas
of DM 500.00/mt for the processors which are certified in the DSD-sector,
that will in fact change in the next few years.

30 Naturally large corporate groups with enormous levels of expenditure
are in a position to satisfy the qualitative wishes of some limited customers,
inter alia also abroad. Nonetheless the market for the DSD material still
remains limited. The sole reason are for example problems with dealing

with materials of a single kind in each case, certain odorous fragments and the difficulty of the technical specification which still remains the same.

There is therefore a need at the lowest possible level of expenditure to produce a simple and ecologically meaningful product, starting from a
5 basic raw material which is continuously available and which, unlike the situation with tubes or flanges which can be produced from the DSD granular material, sets only low levels of demand in terms of quality.

WO 94/26086 also discloses plastic granular materials which are produced from polymer materials which are not homogeneously extruded
10 by an extruder and are used in water treatment installations for the cleaning and purification of sewers or sewage and waste water. It will be appreciated that the initial plastic material products used in accordance with that particular process are relatively expensive, and for that reason the industrial use thereof, outside Great Britain, has hitherto not taken
15 place on a greater scale.

As a countermove to these high-qualified plastic materials the invention seeks to afford a remedy insofar as it opens up a new purpose of use for plastic material wastes and in particular those which originate from the dual system in Germany and Europe.

20 The aim of the present invention is to provide a process based on those wastes for producing a granular material as a filter for the purification of sewage, which affords an inexpensive end product in a particularly simple and rapid fashion.

The process steps according to the invention are as follows:

25 a) Procuring and providing this plastic material waste, in particular that from the bottle fraction of the Duales System Deutschland DER GRÜNE PUNKT,

b) cleaning and chopping that plastic material waste and then drying same,

30 c) heating same at about 280° to the molten state,

d) extruding same, in particular at degressive temperatures, by way of a screw or cascade extruder, in particular at a rotary speed of between

260 and 300 rpm, and a mass pressure of between 130 and 150 Kp/cm², and

e) cooling the molten material and cutting and/or sieving off the granular material in the desired length.

5 Surprisingly therefore it has been found that in actual fact pre-sorted plastic material waste as occurs with DSD in the form of a waste product, can be used not only as a recycling product but also a granular material produced therefrom can be used as a filter for the purification of sewage. That is a particularly ecological form of exploitation which affords an
10 extremely inexpensive starting material. Hitherto the men skilled in the art have not thought of such a system which operates in a circulatory mode, on the basis of regularly available DSD granular materials, as apparently the principle according to the invention of 'purifying waste (sewage) with waste' involves a major inhibition.

15 While in accordance with the invention a cascade extruder operates without peroxide, it is advantageous in terms of the process for a small amount of peroxide to be added for cross-linking purposes to the DSD base product in the screw extruder, giving a homogeneous end product. Advantageously, for that purpose only between about 10 and 20 and in
20 particular 15% by weight of the DSD plastic waste material is mixed with the peroxide additive, for example dicumyl peroxide at 40% in PE, or peroxide-bearing waste materials, in particular chopped or ground floor heating tubes, in order to achieve the largest possible surface area for the granular material, whereby the colonisation of micro-organisms is possible
25 and the longevity of the granular material is increased.

The degressive temperature control in conjunction with the peroxide provides for a resistant surface area for the granular material, which is as large as possible and which permits micro-organism colonisation. The peroxide also affords the advantage that in this case with the longevity in
30 question this involves a system which after purification can in practice be used repeatedly.

A preferred embodiment of the operating procedure according to the invention is described in greater detail hereinafter:

- preparing a mixture in a mixing silo:
about 85% by weight of DSD material, cleaned and dried
ground bottle material,
about 15% by weight of PE compound (contains about 2%
5 peroxide);
- alternatively:
about 15% by weight of PE ground material from floor heating tubes
(note: in the case of cascade extruders, no 15% by weight admixing is
necessary)/(the term cascade extruders is used to denote two extruders
10 which are connected together);
- heating the extruder;
 - starting the extruder with adjustment of the heating zones (falling
degressively from 270°C/melting of the introduced ground bottle material -
200°C) and of the cutting tools for regulating the granular material size;
 - 15 - starting degassing (in the case of cascade extruders double
degassing possibly necessary);
 - addition of 1% black master batch (that is to say a color additive
by way of a metering installation, color is actually not necessary but
improves optical aspect/impression;
 - 20 - setting the screw rotary speed, individually according to the
respective type of extruder, in most cases at 300 rpm;
 - a mass pressure of about 130 kg/cm² is correspondingly reached;
 - extruding the mixture by way of an extruder by way of a 400 μ
sieve;
 - 25 - extrusion through a 1.5 mm apertured plate. A man skilled in the
art can envisage other sizes;
 - cooling the granular materials by way of a water bath;
 - cutting and sieving off the oversizes and undersizes of the granular
materials;
 - 30 - sucking off into a storage silo;
 - bagging from the storage silo in for example 1200 kg bags; and
 - setting down the bag on a wooden board.

The bottle fraction of the DSD was investigated on the basis of various samples, the results of which are set out hereinafter:

Plastic material bottles		
Specification	Purity	Impurities
Bottles \leq 5 liters volume content (for example shampoo bottles, detergent bottles, domestic cleaners)	min 94% IL specification max 3% impurities max 3% other plastic material packagings	- metal - glass - paper - foreign materials such as rubber, textiles, wood, stones - composite materials such as plastic material-aluminum (drinks cartons etc) - non-packagings of plastic material (special agreements remain reserved)

1st sample - regranular material from DSD bottle fraction (green-grey granular material)			
Analysis values	Test for	Test procedure	Test result
	PVC	RFA	<0.05%
	Polyamides	Formic acid extract/IR	Non-detectable
	Polystyrene, ABS, polycarbonate, plasticiser, wax etc	Chloroform extract/IR	1.44%
	Fillers, glass fibers, inorganic accompanying materials	Ignition residue at 550°C (DIN 53 568)	0.92%
Comments	The chloroform extract predominantly comprises an aliphatic carboxylic acid ester. It was not possible to detect thermoplastic impurities such as polystyrene, ABS, polycarbonate etc.		
Summary	The extraction residue comprises a mixture of polyethylene (main component) and marked amounts of polypropylene. Impurities are not detectable IR-spectrometrically.		
	After consideration is given to the impurities determined in 5 there is a content of polyolefins (PE/PP) in sample A of $\geq 97\%$.		

2nd sample - ground material from DSD bottle fraction (from a further manufacturer)			
Analysis values	Test for	Test procedure	Test result
	PVC	RFA	<0.05%
	Polyamides	Formic acid extract/IR	Non-detectable
	Polystyrene, ABS, polycarbonate, plasticiser, wax etc	Chloroform extract/IR	1.14%
	Fillers, glass fibers, inorganic accompanying materials	Ignition residue at 550°C (DIN 53 568)	1.03%
Comments	The chloroform extract predominantly comprises an aliphatic carboxylic acid ester. It was not possible to detect thermoplastic impurities such as polystyrene, ABS, polycarbonate etc.		
Summary	The extraction residue comprises a mixture of polyethylene (main component) and marked amounts of polypropylene. Impurities are not detectable IR-spectrometrically.		
	After consideration is given to the impurities determined in 5 there is a content of polyolefins (PE/PP) in sample A of $\geq 97\%$.		

5 The process according to the invention therefore shows that the plastic material used does not have to be sterile and new for each use and precisely not for use as a filter, but on the contrary the products described and claimed can be employed for that purpose.

Besides the described possibility of using in particular plastic material wastes from the bottle fraction, it is also possible to use mixed plastic materials.

10 If problems arise by virtue of fluctuations in density in the mixed plastic materials, such fluctuations in density can be compensated by the addition of fillers such as for example chalk so that the resulting granular material grains are always of the desired density and can be suspended in water.

15 The invention also includes the possibility of not only preparing the granular material as a filter substrate but also as a carrier for micro-organisms, by means of which then a fluid can be treated in the desired manner if the granular materials are colonised together with the micro-organisms for example in a water treatment apparatus.